

the radius vector. An effort to bring into quantitative correlation such constants as density, eccentricity, or inclinations of axis, must end in failure for Kant. He will be judged, not by details, but on the general principle by which he claimed to have arrived at a just comprehension of a complete cosmogony. Similarly, one may pass over his genesis of satellites and the formation of Saturn's ring. Of the former it is sufficient to say that both Kant and Laplace saw in the existence of satellites the repetition on a small scale of the formation of the solar system. We know now the extreme probability that the moon owes its existence to a quite unique arrangement, and it would be hazardous to affirm that any one process has been operative in more than one planet. With regard to the latter, if the existence of a ring about Saturn is suggestive of the manner in which planets came into existence, neither Kant nor Laplace could give sufficient reasons to account for the stable condition of the ring in that system and the instability in others.

The problem of the ordered solar system is one around which much future controversy will arise, and possibly the ambition of neither the astronomer nor the physicist will go further than to suggest how it might have been effected on a plan that does not contradict any known physical laws or inferences. This is very different from saying how it actually "rose out of chaos." Prof. Hastie quotes with approval a remark of Kant, "that it is more difficult to explain the genesis of a caterpillar than the origin of a world." If this be true, it may be due to the fact that we know less about the fabric of the Universe than of the caterpillar, and it is consequently easier to be convicted of error in the smaller than in the greater matter. Kant, together with all makers of cosmogonies, enjoys the advantage that the accuracy of the theories cannot be submitted to any adequate test. W. E. P.

THE HERPETOLOGY OF NORTH AMERICA.

The Crocodilians, Lizards, and Snakes of North America.

By E. D. Cope. Reprinted from the Report of the U.S. National Museum for 1898, pp. 153-1270. With woodcuts and 36 plates. (Washington, 1900.)

THE eminent position held by the late Prof. Cope among workers on the taxonomy of vertebrates in the latter half of the past century is chiefly due to the fact that, as has been the case with Prof. Gegenbaur in the field of comparative anatomy, he applied the teachings of the evolutionary theory from the very outset, at a time when other zoologists, imbued with the Cuvierian and Müllerian principles, were still striving at natural arrangements on physiological bases. The ideas set forth in the revolutionary essays on the classification of Batrachians and Lizards, by which he first made his name known, though at first received with little favour by his fellow-workers in Europe, have gradually made their way, and may be said to have well stood the test of time. Although considerably modified in many points both by himself and by others in the intervening thirty-five years, Cope's views hold the field to a greater extent than those of any other taxonomist of the same period. Later in his career, similar attempts at the general classification of Reptiles and Fishes have, in the opinion of the reviewer, been equally successful.

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The quick perception of the importance of apparently trivial anatomical details, the veritable instinct with which he realised their phylogenetic bearing and selected them for the purpose of connecting forms widely remote in the systems of his predecessors, and led to conclusions which have, in many instances, ultimately been confirmed by palæontological discoveries, have rendered his name famous in Europe as well as in America. During the later years of his life, however, hasty and careless work, a constant striving at originality, to a certain extent marred the productions of his never-ceasing activity. This may be said of his latest attempts at improving the classification of the Lizards and Snakes, the results of which are incorporated in the thick volume of over 1100 pages now issued by the Smithsonian Institution. It is not stated by whom the work has been seen through the press, nor whether and to what extent the original MS. has been touched up, an omission through which it appears uncertain whether the late author or the editor is responsible for various startling errors which one feels disinclined to ascribe to the former.

The present volume forms part of a series of monographs intended to illustrate the cold-blooded lung-breathers of North America, a work which was devised many years ago by the late Prof. Baird, whose MS. and a number of carefully-drawn figures were placed in the hands of Prof. Cope in 1864. The Batrachians appeared in 1889, the Chelonians were to have been described by Prof. Baur, whose death so nearly followed that of the author of the present treatise, dealing with the remaining orders, viz., *Loricata* (Crocodiles) and *Squamata* (Lizards and Snakes).

As regards the first of these two orders, which includes only two North American living types, *Alligator mississippiensis* and *Crocodilus americanus*, it seems surprising that so advanced a reformer of classification should still have adhered to the inclusion of the *Parasuchia* among the Crocodilians. These Triassic types differ in so many respects from the later *Eusuchia*, and have so much in common with the Rhynchocephalians and the Sauropodous Dinosaurs, that their separation as a distinct order (*Thecodontia*) appears imperative if exact definitions of the allied groups are to be attempted.

Prof. Cope's arrangement by which the *Lacertilia*, or *Sauria* as he prefers to call them, and *Ophidia*, forming the bulk of the fauna, are brigaded under *Squamata* is well in accordance with the present state of knowledge, the supposed characters on which the two groups were formerly allowed ordinal rank being quite insufficient for that purpose. But, in the opinion of the reviewer, a classification in which the *Rhoptoglossa* (Chameleons) are regarded as a mere super-family of Lizards, equivalent with the *Pachyglossa* (*Agamidae*, *Iguanidae*), *Nyctisaura* (*Geckonidae*, *Eublepharidae*), *Uroplatoidea*, *Thecaglossa* (*Varanidae*), *Helodermatoidea*, *Diploglossa* (*Zonuridae*, *Pygopodidae*, *Anguinae*, *Xenosauridae*), *Leptoglossa* (*Teiidae*, *Xantusiidae*, *Lacertidae*, *Gerrhosauridae*, *Scincidae*, *Acontiidae*, *Dibamidae*, *Anelytropidae*), *Annielloidea* and *Annulati* (*Amphisbaenidae*), absolutely fails to express the degree of relationship between them and the members of other families; and if one turns to the synopsis on pp. 200 and 201, in which the distinctive features of the

primary groups, here inadvertently termed "orders" and "suborders" (*cf.* p. 178, where the *Sauria* are described as a suborder), are set forth, one cannot fail to be struck by the want of logic and of perception of proportions which characterises the new arrangement. It may also be pointed out that the group *Annielloidea* has been omitted from the synopsis; this is but one out of many clerical oversights of a similar kind which a rapid inspection of the volume reveals.

A glance at the definitions of the species in the difficult genera, such as *Sceloporus* and *Cnemidophorus*, shows that the subject has not been mastered. An attempt to name an extensive series of *Scelopori* with the aid of the key given would, it can be predicted, result in failure.

In the classification of the snakes, the author agrees with the reviewer in the main divisions. The innovations are mainly due to the consideration of the structure of the intermittent organ or "hemipenes" of the male, by the use of which character many changes have been introduced in the limits of the genera and in their groupings, changes which are not likely to meet with general acceptance. Far too few species have as yet been tested with regard to this character, and Cope himself admits of occasional exceptions, which have turned up in the course of his investigations, such as when one of the paired organs has proved to belong to a division of his system different from that of its fellow on the same specimen. *A priori*, it does not seem that the development of folds and spines on such an organ is at all likely to have so deep a signification as to assist in establishing subfamilies and genera; to adduce a somewhat parallel example, we might as well attempt to employ the differences in the nuptial excrescences of male Batrachians for the definition of genera and even higher groups. And if we are to judge of the value of the character by the changes which its consideration warrants in the groupings of the genera, its introduction in the system does not appear as anything in the way of an improvement.

The investigation of the lung characters, to which the author has devoted so much attention, is a more useful piece of work, so far as taxonomy is concerned, and it may be mentioned that through it the view once propounded by the writer of this notice that the Amphisbænids may be directly derived from degraded types of Teiids, has proved to be untenable.

Allusion has been made above to some extraordinary errors which have crept into this work. Two may be mentioned, *à propos* of snakes, as illustrations:—P. 1127, the *Hydrophiinae* are stated to "leave the water to deposit their eggs"; p. 1129, *Echis carinatus* is described as the "Krait" of India.

The illustrations are numerous and for the most part excellent, and an interesting essay on the geographical distribution of Batrachians and Reptiles concludes this monograph, which, in spite of its imperfections, such as it is a reviewer's duty to point out, will prove of great service to the student of a highly interesting but most difficult group of animals, our knowledge of which has been so greatly advanced by the genius and industry of Prof. Cope. The work is also useful as a catalogue of the specimens preserved in the United States National Museum in Washington.

G. A. B.

PRACTICAL PHOTOMETRY.

Photometrical Measurements. By W. M. Stine, Ph.D., Williamson Professor of Engineering, Swarthmore College. Pp. xi+270. Illustrated. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1900.) Price 6s. 6d. net.

AS a "manual for the general practice of photometry, with especial reference to the photometry of arc and incandescent lamps," this work will be found useful. Most of the descriptions of photometers are clear and well illustrated, and much practical information about standards of light is collected together. That strange medley of apparatus enshrined in an expensive tabernacle of mahogany and velvet called by gas engineers a "photometer" is not even mentioned, possibly because the book is of American origin. Photometers, and those parts of the art of photometry which are of use to engineers, may be defined without much difficulty, and the apparatus and methods suitable for the research laboratory may be grouped together; when to these is added the theory of the subject, the whole ground of photometry is covered. But the author makes no such distinctions, and the value of his work suffers. While his reference to spectro-photometry is meagre, and the bolometer is dismissed in less than six lines, he drags in double integration to determine the mean spherical intensity of a purely academical case of distribution. On the other hand, he treats possible cases of distribution in a clear and practical way. The description of a Bunsen photometer in the crude form of a screen without mirrors or prisms, and an ancient algebraical theory of the Bunsen screen, containing no reference to the angle of emission or direction of view, marks the author, as do many other passages, as a science teacher. He is in good company; there is hardly a text-book of physics in English in which that useless affair is not represented as a Bunsen photometer. In common with most science teachers, he assumes that the shadows of a Rumford photometer must be widely separated, and he very properly alludes to the lack of sensitiveness which results. When Lord Kelvin said that no one could need a better photometer than a pencil and a white card he knew that the edges of the shadows should meet, and, it may be added, that the shadows should completely cover the card. The little-known, but valuable, Conroy, Ritchie and Thompson photometers, varieties of the Rumford, are described, and the somewhat over-rated Lummer-Brodhun apparatus is criticised. To describe the use of the rotating sector without allusion to Abney, the light of the arc without reference to Fleming, S. P. Thompson or Mrs. Ayrton, and measurement of the mean spherical candle power of arcs without reference to Blondel, can hardly be excused by the attempt to compress the whole book into 261 pages. That the author is a professor of engineering may account for the excellence of the practical parts of the manual; but that, being a professor, some of the theoretical parts are so obscure is strange.

He must needs allude to "the logarithm of the ratio" in defining Fechner's law, because he is a professor; he goes on to give a lucid arithmetical example, because he is an engineering professor, but after a page relapses